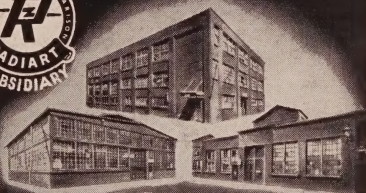


The CORNELL-DUBILIER **Capacitor**



The RADIART Corp.
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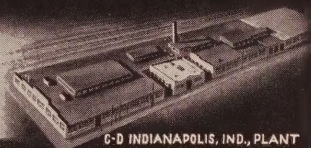
C-D PROVIDENCE, R.I., PLANT



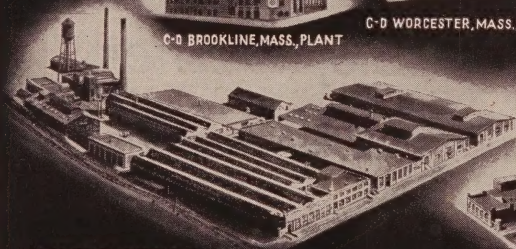
C-D BROOKLINE, MASS., PLANT



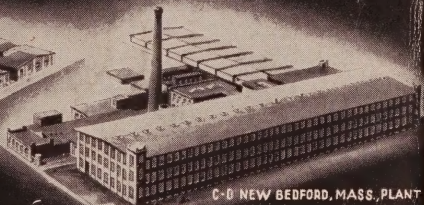
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C-D SOUTH PLAINFIELD, N.J. PLANT



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Vol. 16

MAY, 1951

No. 5

CORNELL-DUBILIER ELECTRIC CORP.
Hamilton Boulevard, South Plainfield, N. J.

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self-healing feature means extra long service life.



Write for Bulletin N142.
Cornell-Dubilier Electric Corp.
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METALLIZED PAPER CAPACITORS

By WILLIAM BAILEY
Vice-President and Chief Engineer
Cornell-Dubilier Electric Corp.
New Bedford, Mass.

PART II (Continued from April Issue)

Soldering of Terminals. Terminal leads are soldered to the ends. In one type of assembly each lead has a doubled-over end or a pancake-like spiral ("pigtail") that is soldered directly to the end of the capacitor unit. In another type of assembly, the inner ends of the leads are headed and pushed out through holes in tinned metal caps that are soldered over the ends of the rolled capacitor unit as in Fig. 8. For hermetically sealed units the same soldered connections are employed but the techniques are modified to accommodate the glass beads that insulate the leads from the metal housing.

Housings. The next step is encasement in a housing that provides protection against mechanical damage and

varying degrees of additional protection against entrance of moisture. However, the final seal is made after impregnation. The four types of housings in common use for paper capacitors, listed in the order of increasing protection against moisture, are:

(1) Impregnated paper tube with metal end caps as in Fig. 9A. (C-D metallized paper capacitors using this housing are called **Pups**).

(2) Complete embedment in molded or poured thermosetting plastic (not used as yet for C-D metallized capacitors).

(3) Metal tube with rubber bakelite end discs as in Fig. 9B (C-D metallized paper capacitors using this construction are called **Metapups**).

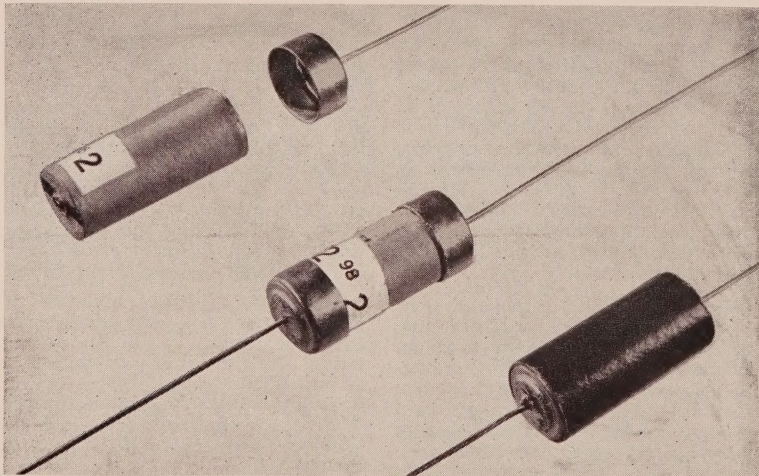


Fig. 8. Steps in applying terminals and housing of C-D Pup metallized paper capacitor.

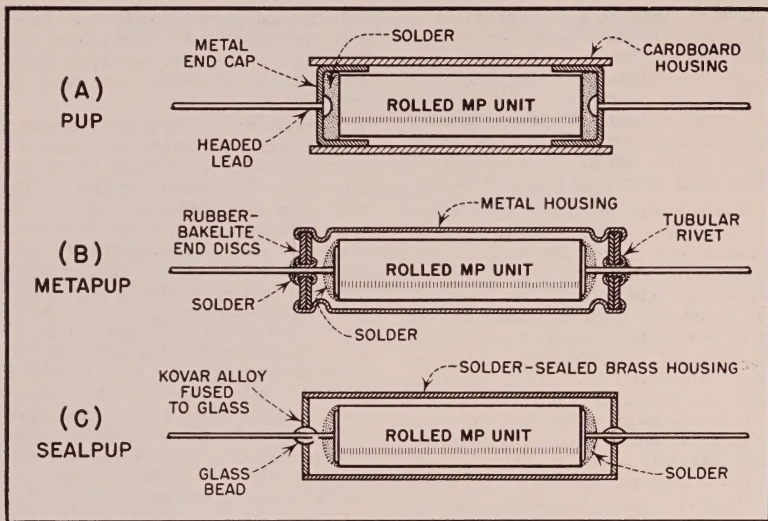


Fig. 9. Types of housings used with C-D metallized paper capacitors.

(4) Metal can with glass-Kovar end seals around leads for complete hermetic sealing as in Fig. 9C (C-D metallized paper capacitors of this type are called **Sealpups**).

The choice of housing for a metallized paper capacitor is governed by the degree of protection needed against moisture in the location of intended use. Moisture is the big enemy of all paper capacitors. Once it gets inside the housing and enters the dielectric, it lowers the insulation resistance near the ends of the windings, and can cause premature failure. In high-humidity tropical locations requiring maximum reliability, hermetic sealing as in **Sealpups** is essential.

Impregnating. The assembled units are dried with heat in a vacuum chamber that is pumped down to about 150 microns of mercury. This reduces the normal 6-per cent moisture content of capacitor paper to a value approaching zero. After this, mineral wax or mineral oil impregnant is admitted to the vacuum tank without stopping the heat source and vacuum pump. The

units are held under vacuum and heat for 4 to 6 hours to obtain thorough impregnation without exposing the dried units to the atmosphere.

Metallized electrodes are so thin that even a moderate amount of electrolysis can destroy them. Moisture and a d-c operating voltage together provide the necessary conditions for electrolysis. The impregnant, the impregnation cycle, and the method of sealing the finished unit against moisture must, therefore, be carefully chosen and controlled. The trend to aluminum for metallized coatings is due in part to its greater resistance than zinc to electrolysis. It is also easier to make a firm end connection to an aluminum coating.

For voltage ratings of 200 volts and lower, mineral wax is generally used as the impregnant. For higher voltage ratings, mineral oil is used because it allows a higher electrical stress per mil of paper thickness than does the wax. The units are then solder sealed at the lead hole, then cleaned and are ready for test.

Final Testing. Any shorts or incipi-

ent flaws that develop subsequent to impregnation are cleared by a final overvoltage, which oftentimes also boosts the resistance. This final overvoltage test is run at $1\frac{1}{2}$ times the d-c rated voltage. Tests for capacity, insulation resistance, and power factor follow, after which the units are labeled and packed in shipping boxes.

Revitalizing. In rare cases a metallized paper capacitor may become shorted during shelf life or during use in a circuit where the source does not have sufficient current to clear the fault and the capacitor itself did not hold sufficient energy to discharge through the fault and clear it. In this case, the shorted unit can be made as good as new simply by charging up a .25 mfd. or larger capacitor to the rated voltage of the shorted unit, then discharging this capacitor directly across the shorted unit.

Though small values of capacity, below about 0.01 mfd., cannot store enough energy themselves for clearing shorts, the voltage pulse that causes a breakdown in a small unit will as a rule simultaneously clear the short.

Large Capacitors. Burn-outs involving substantial expenditure of energy are undesirable because of the danger of destroying the dielectric and leaving a permanent conducting path between the electrodes. The amount of energy involved increases with capacity and with the square of the operating voltage, hence special precautions are needed to insure self-healing in high-capacity and high-voltage metallized paper capacitors.

Subdividing the capacitor into many partial capacities connected together through decoupling resistive elements reduces or prevents neighboring elements from supplying full energy during a breakdown; this can effectively reduce burn-out energy to a few per cent of the original value.

Decoupling is also obtained by special pattern printing, which subdivides the individual metallized surface elements by substantial resistance paths that reduce burn-out energy in case of breakdown.

Metallized paper capacitors in large sizes are widely used in England and Germany. Typical of the larger English units is a 240-mfd. unit rated at 350 volts d-c.

Characteristics. The initial characteristics of metallized paper capacitors are similar to those of conventional paper-foil types. The reason for this is that both types of construction employ the same capacitor paper as the dielectric, along with the same impregnating and housing techniques. Characteristics governed solely by the dielectric remain comparable throughout the useful life of both types. Characteristics affected by the self-healing action of the metallized capacitor and by the thinner electrodes will, of course, show some deviation from those of foil-paper types during life tests. To present the complete performance picture for the new metallized types, each characteristic will now be taken up in turn.

Volume. Maximum reduction in size is obtained at voltage ratings of 200 volts and lower, because the dielectric is then reduced to a single sheet of paper between the electrodes, with no interleaving. Reducing the foil thickness and the conventional two thicknesses of paper to one reduces the volume of a metallized paper unit to about one-fourth that of paper-foil units; the reason for this is that removing one sheet of paper halves the thickness of the dielectric and hence doubles the capacity, so for the same capacity only half the electrode area is needed. Half as much dielectric between half as much electrode area gives one-quarter of the volume.

At voltage ratings above 200 volts, one or more extra sheets of plain insulating paper must be used between the metallized paper to withstand the higher voltages. For 400-volt and 600-volt ratings one interleaving sheet is used, with a thicker paper for 600 volts than for 400 volts. The saving in volume is less at higher voltages, but even for voltage ratings up to 1,000 volts it is still significant because metallized paper with its self-healing action generally requires one less sheet of paper than the corresponding paper-

foil construction and the test voltage is only $1\frac{1}{2}$ times rating.

The approximately 75-per cent volume reduction in low-voltage units has made the metallized paper capacitor highly advantageous for telephone applications. Units made by Western Electric Co. for this purpose use zinc for the metallized layer. The Bosch Co. in Germany, reported to have made some 40 million metallized paper capacitors during World War II, also used zinc.

The type of housing employed will, of course, affect the percentage saving in volume achieved with metallized paper. Examples of volume savings for three different voltage ratings of a 0.25 mfd. unit in a paper-tube housing are given in Fig. 10.

Capacity Tolerance. Variations in paper thickness, tightness of winding, type of impregnation, and length of winding affect the final capacity of any rolled paper capacitor. For 1 mfd. and larger metallized paper capacitors, the standard capacity tolerance is plus 30 per cent and minus 20 per cent; for smaller units it is plus 40 per cent and minus 20 per cent. This seemingly

wide range is no drawback for most applications, since paper capacitors are rarely used for tuning purposes. Units with lower tolerance, down to plus or minus 10 per cent, are also available.

Life Tests. Accelerated life tests of metallized paper capacitors are run by combining high voltage with high temperature. At the abnormally high voltage, considerable sparking and resultant self-healing occurs, corresponding to many many more hours in normal operation. These life tests show that the amount of permanent damage to the dielectric is negligibly small, with little or no change in insulation resistance. In some instances the insulation resistance actually goes up, possibly due to isolation of the partial faults that originally pulled down the resistance.

In the standard life test on metallized paper capacitors, they are subjected to 125 per cent of rated voltage at 60°C. for 250 hours for "Pups" (or 125 per cent of derated voltage at 85°C. for 250 hours for "Metapups" and "Sealpups"). At the completion of the test, there should be not more than one failure for each 12 capacitors tested.

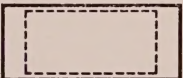
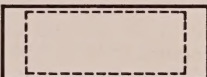
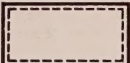
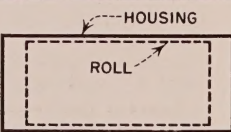
RATING	CONVENTIONAL FOIL and PAPER	METALLIZED PAPER	SAVING IN VOLUME
0.25 MFD. 200 D.C.W.V.			82.3 %
0.25 MFD. 400 D.C.W.V.			60 %
0.25 MFD. 600 D.C.W.V.			73 %

Fig. 10. Comparison of cross-sections of corresponding electrical sizes in the two types of paper capacitors. Saving in volume for 200-volt unit exceeds the theoretical 75% for metallized paper because of more compact terminal arrangement used on the metallized units.

A resistance of one ohm per volt of applied voltage should be connected in series with each individual capacitor during a life test. This is an extremely severe test, hence a reject rate of not over 1 in 12 is assurance that the units will all be reliable under normal rated operating conditions.

Some specifications for metallized paper capacitors call for counting the number of self-healing actions during accelerated life tests. Since an electrical pulse or click is produced by the momentary short-circuit and resultant capacitor discharge during the self-healing action, Geiger-counter equipment can easily be adapted for this purpose.

In accelerated life tests, C-D metallized paper capacitors show only 1 to 3 per cent change in capacitance, which is negligibly small in comparison to the normal capacitance tolerances. This

change is believed to be due only to the characteristics of the impregnant.

Life Expectancy. The goal in metallized capacitor design is to provide the same life as foil-paper with smaller physical size, since properly selected paper capacitors for a particular application are already outlasting electronic equipment designs. Foil-paper and metallized-paper units can, therefore, be considered on a par as regards life. Life of a paper capacitor can always be prolonged by operating at lower than rated voltage (using a unit having a considerably higher working voltage rating than is encountered in the equipment), just as the life of a lamp or radio tube can be lengthened by cutting down the filament voltage.

Derating for High Temperatures.

The life expectancy of any paper capacitor decreases at higher temperatures. Reducing the voltage rating offsets this effect, hence the following derating figures should be observed when operating metallized paper capacitors at voltages above 60°C.:

Temp. in °C.	Per cent Reduction in Voltage Rating	
	400 and 200 DCWV	600 DCWV
60	0%	0%
65	5%	5%
70	10%	10%
75	15%	15%
80	25%	20%
85	35%	30%
90	50%	40%
95	65%	50%

As an example, a 200-volt unit that is to be operated at 80°C. would be derated 25%, to 150 dcwv. The above figures are for continuous duty at the elevated temperature. For intermittent duty at elevated temperatures, less derating is needed. For the normal temperature range of -40°C. to 60°C., rated d-c working voltages apply.

Leakage Resistance. The resistance of a capacitor is principally that of the dielectric area between the electrodes. Since a metallized paper capacitor has as a rule been "self-healed" during manufacture, the insulation resistance

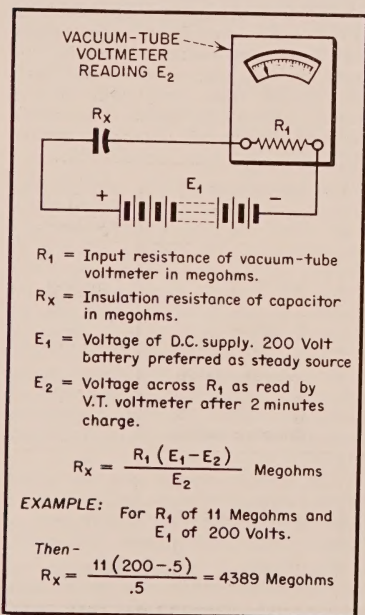


Fig. 11. Recommended method of measuring insulation resistance of a metallized capacitor.

of this type will be inherently lower than the foil paper type. For 200 dcwv units the resistance will be at least 2,000 megohms or 600 per mfd. and for 400 and 600 dcwv units, the minimum resistance is 3,000 megohms or 1,200 per mfd. when measured on new units at 25°C. These values should be measured with a d-c voltage of at least 100 volts (or preferably the rated working voltage) applied to the capacitor for at least 2 minutes prior to measurement. A suitable measuring arrangement using a vacuum-tube voltmeter is shown in Fig. 11.

Insulation resistance is highest for low-capacitance units. Therefore, if a 1 mfd. unit, as noted above, has 600 megohms minimum, a 4 mfd. unit would have one-quarter of this resistance, or 150 megohms minimum. Likewise, a .1 mfd. would be expected to have ten times 600 megohms or 6,000 megohms; but remember, the minimum megohm value required per capacitor for small capacitors is 2,000 and 3,000 megohms. These figures take precedence over the calculated resistance for low-capacity values. Therefore, the 6,000 megohms should be reduced to these lower minimum figures which, of course, are exceeded in practice.

The insulation resistance may vary somewhat with the type of housing used, since the sealing and external insulation differs. Leakage resistance of all paper capacitors decreases as temperature increases, this being a characteristic of the paper and impregnant rather than the electrodes. Accelerated life tests of metallized paper capacitors sometimes show an improvement (increase) in resistance. This phenomenon is believed to be due to movement of ions through the dielectric to the electrodes by electrostatic attraction during use. When all the free ions in the dielectric material have been pulled over to the electrodes, the resistance has reached its maximum value. Subsequent decrease in resistance is then due to cumulative effects of self-healing actions, as each fault-clearing arc heats and deteriorates the dielectric slightly.

The varying and slightly lower re-

sistance characteristics of metallized paper capacitors make them less well suited than conventional paper capacitors for such applications as grid-plate blocking capacitors, RC timing circuits, RC audio oscillators and other circuits where the amount of resistance is critical.

Power Factor. This characteristic (series Resistance divided by Reactance) depends on internal resistance, quality of paper, the impregnant, and the manufacturing technique. Typical metallized paper capacitors have a power factor of .005 at 60 cycles.

Poor contact between the capacitor leads and the edges of the foil can raise the power factor, but this is unlikely because of the assembly technique used in metallized paper capacitors.

At frequencies up to 1,000 cycles, the higher resistance of the metallized coating on small capacitors makes little change in power factor. The resistance of the coating does not become a factor until radio frequencies and higher currents are reached, or when the units are wound from very wide coated paper. Even at radio frequencies, however, the power factor is satisfactorily low for most applications.

R-F Impedance. Although thin metallized coatings have higher resistance than solid foil, the thinness becomes an advantage at higher frequencies. Because of the skin effect, the radio-frequency current flows only on the outside of an electrode, and the remaining inner metal merely serves as a highly conducting path for eddy currents. As a result, metallized paper capacitors generally have an improved lower impedance at radio frequencies than the same ratings of foil-paper capacitors.

The smaller size of the metallized paper units provides further advantages in high-frequency circuits such as shorter paths with lower inductance.

Test Voltage. Metallized paper capacitors in all ratings should be tested at a maximum of 150 per cent of the rated working voltage applied for a period not to exceed one minute. The voltage should be applied through a

resistance sufficient to limit the charging current to between 5 ma and 1 amp, and the capacitors should be discharged through the same resistance.

Relative Costs. At the present time, any saving in cost through use of metallized paper capacitors is indirect, as the units cost more than comparable foil-paper units. It is the weight and size reductions that in many applications provide appreciable savings in cost. One example of an indirect saving is reduced chassis and cabinet cost. Another is the increased market value of lighter weight equipment for airborne and portable applications, where each added ounce of capacitor weight reduces the allowable carrying load correspondingly.

General Applications. In portable radio equipment, the reduction in capacitor weight permits carrying heavier batteries or adding extra stages for the same weight, to get greater transmitter power, greater range, greater receiver sensitivity and longer life per set of batteries.

Metallized paper capacitors are excellent for hearing aids, where their extremely low size and weight are both important factors. Many are going into miniaturized equipment for the same reason and for added immunity to transient pulse failures. Large quantities of metallized paper units have been used for interference suppression on aircraft and automotive circuits. Some have found service for power-factor correction in fluorescent lamps, particularly in Europe. Excellent results have been obtained also with low-voltage capacitor-run a-c motors, with resonant transformers, and with voltage stabilizers. The telephone industry has long recognized the advantages of metallized paper capacitors, and is today perhaps the biggest user of all.

A-C Applications. Just as for any capacitor, in an a-c circuit the peak value of the a-c voltage must never exceed and is usually less than the d-c working voltage rating of a metallized paper unit. Self-healing action is improved on a-c, because the arc that under certain conditions might damage the dielectric is stopped within half a cycle

as the a-c voltage passes through zero. A possible drawback offsetting this in a-c circuits, however, is the slightly higher power factor of some metallized paper units as compared to foil-paper units; the higher power factor means more generation of heat in the dielectric while the reduced metal thickness and much lower heat-radiating surface tend to increase temperature rise.

Metallized paper capacitors are not recommended at present time for photoflash and similar applications where heavy current pulses are liable to burn open the foil at the end connections, or for high-frequency a-c power circuitry involving heavy current loading as in connection with induction furnaces. Even these limitations may disappear, however, as manufacturing techniques are further perfected.

Summary. The three outstanding advantages of a metallized paper capacitor over conventional paper-foil types are reduced size, reduced weight, and self-healing action. The size and weight reductions of up to 75 per cent are predicated on the same voltage rating and life expectancy; conversely, if the two types are made with the same size and weight, the metallized paper unit will have a much higher capacity or a higher voltage rating and/or much longer reliable life expectancy. The self-healing action is a reserve for protection against over-voltage in use, since at rated voltage a high-quality metallized paper capacitor will as a rule operate indefinitely without going through a single self-healing action.

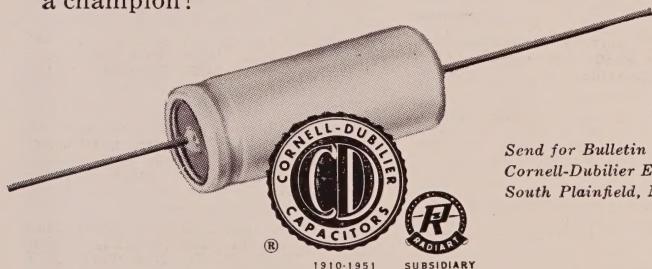
Where space and reliability are at a premium, as in high-grade Army, Navy, Air Corps, and commercial electronic equipment, the hermetically sealed Cornell-Dubilier Sealpup is definitely recommended as the smallest type available with high reliability. Other advantages, already discussed, are low loss at high frequencies, the small change in capacitance with temperature and life, and the highly attractive insulation resistance and power factor characteristics as compared to other types of miniature capacitors of comparable electrical sizes. — END.



C-D's Metapup

Best by Field Test!

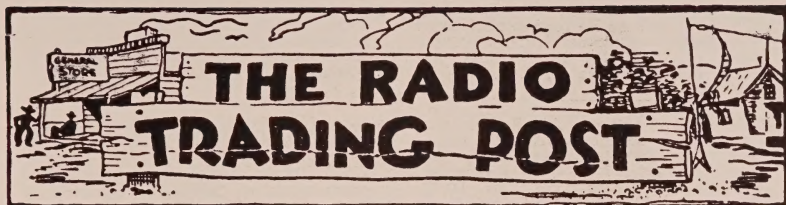
Chassis space at a premium? Dependability a "must"? Then the job calls for METAPUP, C-D's new and advanced metallized paper tubular capacitor. Metal-encased, hermetically-sealed, self-healing, ultra-compact...every inch a champion!



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South Plainfield, N. J.

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These columns are open only to those who have a legitimate WANTED, SELL, or SWAP proposition to offer. The Cornell-Dubilier Electric Corp. reserves the right to edit advertisements submitted, and to refuse to run any which may be considered unsuitable. We shall endeavor to restrict the ads to legitimate offers but cannot assume any responsibility for the transaction involved.

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WILL TRADE—Hallicrafter S-38 in good condition for a radio-phonograph table model combination, or what have you? E. P. Riffle, 207 Davies St., Ludlow, Ky.

FOR SALE—9 Rider Manuals 1-5 abridged, 6, 8-14, \$85; Vomax 900, \$25; Triplett sig. gen. 2432, \$60; Simpson tube tester 330, \$70; Electroxx battery eliminator AR1, \$15. Lot for \$240. All in excellent cond. Don Varnum, Box 434, Osterville, Mass.

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TRADE—Used radio tubes in good cond. Want other radio and TV tubes. Robert Ansell, 322 E. 126 St., New York, N. Y.

WANTED—Precision E-200C sig. gen. Also Rider Manuals vols. 15, 17, 18, 19. Castle Hill Radio Shop, 2228 Newbold Ave., Bronx 61, N. Y.

WANTED—Communication receiver, small 12" panel, such as Howard or Skybuddy. Have cash, radios, revolvers, elec. flat irons, etc. Charles H. Doolittle, 415 Irving Ave., Syracuse 10, N. Y.

TRADE—Bell 15watt portable P.A. system, J38 mike on floor stand, 100' mike cable, two 10" speakers in baffles, 250' speaker wire. Trade for 7" TV, wire recorder, ham gear, or what have you? D. C. Brewer, Box 1929, Winston-Salem, N. C.

FOR SALE—10BP4's, perfect, \$10; Tele enlarger, oil, 7" to 10" \$5, 10" to 14" \$7.50; Sparx 905 with manual, \$25; RCP model 308, \$25; American Airlines recs., type AA, 110V a.c., fixed freq., rack panel mount, less 8 tubes and xtal, \$15. A. Livingstone, 1201 Ellis Ave., Fair Lawn, New Jersey.

FOR SALE—RCA vertical transcription pickup, diamond stylus, complete with 16in. arm, \$25; BC-433G receiver, \$15. John H. Schultz, 402 W. N. Grand, Springfield, Ill.

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FOR SALE—Eico VTVM model 221, complete, probes instruction book, subject to drift, but otherwise o.k., \$20; Jewell audio output meter, needs bottom cover, \$5. L. L. Matushefske, 2 Elmont Rd., Elmont, L. I., N. Y.

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FOR SALE—Precision E-200 signal gen. and Hickok 530 tube tester in leather carrying case. Both in excellent cond. Best offer takes both, or 16mm motion picture projector. Daniel Harris, 1776 Weeks Ave., New York 57, N. Y.

SALE OR TRADE—Daco model 606 tube tester and Electronic Design model 100 vacuum tube volt-ohm meter. Want movie camera and projector or typewriter. W. Fieldsend, 1113 So. Chicago Ave., Freeport, Illinois.

FOR SALE—N.R.I. VTVM in good cond., 20,000 ohms per volt — a.c. and d.c. in 4 ranges 0-500, ohms in 3 ranges 0-100 meg. Needs batt., \$10 postpaid. B. Marconi, 120 Gatling Pl., Brooklyn 9, N. Y.

FOR SALE—10" Fada No. 899 table model mahogany TV cabinet (630 chassis), not a mark on it, \$15; 2 German receiving tubes, 6UB11, 6UCH11, at \$3 each; two 6N6G tubes at list each. Packard, 67 Littlefield St., Pawtucket, R. I.

SELL OR TRADE—Riders' vol. 1 to 14 inclusive; Speco battery powered signal tracer. Best offer, test equip., etc., or what have you? H. R. Holtz, 9208 Annapolis Rd., Philadelphia 14, Pa.

SWAP—16mm Cine-Kodak magazine camera with 1" f1.9 Cine Extar focusing lens, in good shape except minus view finder. Trade for comm. set, or test equip., Rider Manuals, etc. L. E. Walker, 118 Columbus, Lead, S. D.

FOR SALE OR TRADE—Sled, \$3; pair 7' skis, \$15; guitar, \$15; small guitar, \$4; a few radios and parts; guns. All in very good condition. Will trade for guns, reloading equipment, or? Raymond Chapell, 472 Elm St., Beddeford, Maine.

FOR SALE—Heath signal generator, 5 separately calibrated bands, vernier tuning, excellent condition, output cable and manual included, \$15. Ernest J. Russ, 1200 E. 17th St., Richmond 24, Va.

TRADE—Kodak tourist camera, f4.5 coated lens, leather case, xl filter, porta 3 lens and hood, pocket range finder. Want Meissner signal shifter model 9-1090 or RME - vhf model 152A conv. in good cond. Lewis Mascara, 197 McKay Ave., Huntington Station, Long Island, N. Y.

FOR SALE—BC-474-A with phone and tubes, \$40; code practice oscillator, surplus, 6-250V a.c.-d.c., \$15; 10 watt amplifier with 12" speaker-6V6 PP., \$12; 5" TV set, needs work, \$20; 20 selenium rectifiers 100ma, \$5. A. Aronstein, 615 Pelham Parkway North, Bronx 67, N. Y.

FOR SALE—RCA 630 TV kit; Heathkit sweep generator kit; heathkit 5" oscilloscope. All complete and in excellent condition. E. Wincor, 6629 No. Rockwell St., Chicago 45, Illinois.

FOR SALE—Latest Deforest's master course in radio and TV, sound, complete with all material for 300 experiments, excellent, 3200 pages of text, \$165 cash. Also tubes for sale. C. Vaillancourt, Jr., Box 5 Uptown, Levis, P.Q., Canada.

POSITION WANTED—Have 8 years experience servicing all makes of radios. Want position as TV serviceman's helper. Must be in vicinity. No drivers license. Milton Maultasch, 535 Grand St., Brooklyn 11, N. Y.

FOR SALE—10 RCA coin operated radios, model MI-13174, 6 tube, BC and SW band. Guaranteed good condition, \$35 ea. f.o.b. N. M. Sadler Radio, 15 So. First, Clayton, N. M.

FOR SALE OR TRADE—Precision E-200 sig. gen., excellent; Hickok tube tester 530, very good; Eico VTVM, excellent. Best offer, 16mm sound projector, or photographic equip. of like value. Daniel Harris, 1776 Weeks Ave., New York 57, N. Y.

FOR SALE—Toastermaster toaster, \$11.50; A. C. Gilbert Co. electric juicer, complete, \$8.50. Both excellent. Milt's Radio Service, 535 Grand St., Brooklyn, N. Y.

SWAP—1500 different, new and used U. S. and foreign stamps, worth \$50. Want Heath tube tester or kit. Charles C. Butler, 16108 S. Main St., Gardena, Calif.

FOR SALE—Admiral 7" TV rec., model 19A11, new CRT, in excellent cond. Cash only to highest bidder. B. A. Neal, Mansfield, Pa.

WANTED—HRO50. Swap S40 cash, or all cash. D. J. Meade, 111-25 202nd St., Hollis, N. Y.

FOR SALE—Vomax 900A VTVM and Hickok 505A 5" scope. Both in excellent cond. \$150 for both. Martin Godofsky, 1171 Elder Ave., New York 59, N. Y.

FOR SALE—BC 348 L, in orig. carton complete with tubes, instruction manual, and conversion diagrams. Never been used or converted, perfect, \$75. Jack Farrell, 19370 Stratford Rd., Detroit 21, Mich.

FOR SALE—Triplett meter model 630, Volt-Ohm-Ammeter, excellent, \$30. Harold O'Donnell, 911 Baldwin St., Pittsburgh 34, Pa.

WANTED—Set-up data for Triplett tube tester, Readrite, model No. 430, or information as to where it can be acquired. Arthur Bradford, Box 35, Hopewell, N. J.

FOR SALE—Hallicrafters S-40 radio, \$65; Panadaptor, \$42. Prefer someone who can pick up equipment. Robert L. Ingram, 4 West Dover St., Easton, Md.

FOR SALE—810 tube, never been used, \$5 plus postage. Preston L. Williams, 415 Liberty St., So. Norfolk 6, Va.

WANTED—Hickok tube tester, model 534B. Also cathode ray tube, 5J1P1. F. Kopischiansky, 303 Hope Ave., Clifton, N. J.

SWAP—We have lots of items for trade or sale. Send us your list. Also have local minerals and rock specimens for trade. Interested in stamps too. Burbage H. Buchanan, Hawk, N. C.

FOR SALE—Shure high impedance "Stato-liner," model 508C, dynamic mike, complete with 25' of cable and Atlas chrome plated desk stand adjustable 8" to 13". A-1 shape, \$15. Otto Pollei, Jr., 118 N. Western Pkwy., Louisville 12, Ky.

WANTED—Amateur 75 meter mobile equip. Trans. and receiver converters, power supplies Gonset 3-30 and clipper, BC1306, etc. Barth Radio and TV, 333 Washington, Chelsea, Michigan.

FOR SALE—National NC-57 receiver, complete with S-meter, perfect cond., first \$60 takes it. E. Salzman, 1766 - 68 St., Brooklyn, N. Y.

WANTED—10" or 12" T V set. Will pay cash or will swap for radio equip. and parts. Fred T. Atkins, 1456 Broad St., Augusta, Ga.

FOR SALE—BC-348Q receiver converted to 110V a.c., good cond., \$85. Paul R. Baughman, Box 397, R.D. 1, Copley, Ohio.

SELL OR TRADE—Unused J. C. Higgins fly, fishing rod. Want Pilot FM tuner, equivalent, or \$15. Dale R. Lee, 1528 W. Union Blvd. Bethlehem, Pa.

FOR SALE—20 x 26 projection TV, 520 sq. in. picture! List \$1,495, sacrifice at \$598. First class shape. Details on request. Forcier, Essex St., Middleton, Mass.

FOR SALE—12" P.M. speaker and one pair of large Selsyn motors operating on 110V 60 cycles. Total price, \$15. R. Stewart, 9967 Grandmont Rd., Detroit 27, Mich.

WANTED—Short wave communication rec. Also a code tape machine. Norman J. McHale, 77 Turner Ave., Buffalo 20, N. Y.

TRADE—Standard brand radio tubes that you want for types that I need, including TV types. Goodwin Radio Shop, Rankin, Ill.

SELL OR TRADE—Remington noiseless No. 8 typewriter, value \$95. Want good VTVM or good tube checker. State value and model numbers. Eddie Gigliotti, R.D. 3, Box 282, Bangor, Pa.

FOR SALE OR TRADE—Pilot FM tuner, very good, \$20, or trade for Heath or E.I.C. VTVM with diagram of tester. Furnish same with tuner if wanted. W. D. Poole, R. 3, Cartersville, Ga.

FOR SALE OR TRADE—AK model 55C radio in good shape, \$7.95; over 65 vol. and tone controls, 35 cents ea. Evan H. Griffiths, Griffiths Industries Unlimited, Rock-Creek Sta, Ohio.

TRADE—Hard to get radio and TV tubes. Want signal generator in good working cond. Ben's Radio Service, 120 Gatling Pl., Brooklyn 9, N. Y.

WANTED—One of the following TV receivers: RCA model 630TS, Hallicrafters model T54 or 505, and Stromberg-Carlson model TV12. State price. J. Leonard Ochs, R. D. 1, Parker, Pa.

SELL OR SWAP—Instructograph, electrically operated, 10 tapes, textbooks used at RCA Institute, best offer. J. Kalenak, 169 Washington Park, Brooklyn 5, N. Y.

FOR SALE—Tubes, parts, \$450; Riders 1-5 thru 14, \$100; Sams 1 thru 48, 55 thru 118, 9 Binders, \$120; Precision 915, \$50; Precision E200 gen., \$30; Good cond. Earl J. Smith, 1037 Bridge St., Colusa, Calif.

FOR SALE—Operadio intercom, Fada and Edwards FM tuners, Heathkit amplifier, craftsman lathe and grinder arbor, small motors, asst. meters, tubes, and radio parts. E. K. Chenoweth and Son, 845 Union St., Warren, Ohio.

FOR SALE—Edison records in good condition, $\frac{1}{4}$ " thick. 27 playable records, not junk. Make offer. A. C. Masciarelli, 565 Main St., Clinton, Mass.

FOR SALE—Jackson oscillator, model 420; Supreme tube tester, model 589. Osc. newly calibrated. Will accept best offer over \$45 for both. Charles Cote, 111 Woodlawn Circle, East Hartford, Conn.

FOR SALE—Two Philco car radios, demonstrators UN6-400, \$20 ea.; Presto record cut screws, \$5 ea.; very good regulation type desk telephones, \$7 ea.; RCA tube manuals with supplements, vol. 1-2, \$4 ea., vol. 3-4, \$4 ea. Harry Kay, Rt. 2, Imlay, Mich.

FOR SALE OR TRADE—Hammarlund Super-Pro receiver SP-400SX with power supply and speaker. Want Omega enlarger with color head, or Pacemaker Graphic outfit in good condition. Local trade preferred. David Pagel, 229 Parham Rd., Springfield, Pa.

TRADE—Masco MA35 amplifier, very good (less spkr.), and RCA aerodynamic mike. Want complete 4 cyl. Crosley engine or 10 h.p. Mercury. Also have a lot of used radio parts. Lowell Spicer, 87 Bedford St., Bath, Maine.

FOR SALE—23 blank $1\frac{3}{4}$ " Audiodisc professional recording blanks. \$1 ea., or trade for what? Harold H. Hingley, Rt. 2, Box 40, Holtville, Calif.

FOR SALE—Complete DeForest Training Course in Radio and TV, including assembled instruments. All material in excellent condition, \$100. E. J. Martin, 43 William St., Hudson Falls, N. Y.

FOR SALE—Scott 12 tube receiver, Navy model SLR-H, non-radiating, covers broadcast and shortwave to 16 mc, good cond., \$95. Al McKenna, 65 Corona St., San Francisco 27, Calif.

WANTED—S-20R, needn't be in good condition, but must be cheap. Jack Margolis, 721 N. Fuller, Los Angeles 46, Calif.

FOR SALE—Sig. gen., Radio City Products, model 705A, probe missing, range 100kc. to 25mc, \$25, or what have you? Emile R. Gelinias, 486 Kimball St., Manchester, N. H.

FOR SALE—12DP7 cathode ray tube, used in TV receiver only 10 hours, \$10 f.o.b. L. E. Bollinger, 61 Winthrop Rd., Columbus 2, Ohio.

WANTED—Emerson 7" TV sets, model 600. State quantity (will accept one or more), condition of each, and price. Thal Electronics, 205 W. 53rd St., New York 19, N. Y.

TRADE—BC-348-Q in A-1 shape, 117V a.c., with speaker in metal cabinet, for a SX-25 or SX-28 and a cash difference. Also want, for cash, a NC-57 and a BC-683. Charles W. Leigh, 162 Passaic St., Trenton 8, N. J.

FOR SALE—Radio tubes, 15 amp. rectifier tubes, 1000 watt model glass slide projector, 16mm movie camera, hand vacuum cleaner, 35mm sound movie film, 8mm movie camera, etc. Make offers, write for information. P. Calderaro, 20 Richardson St., Wakefield, Mass.



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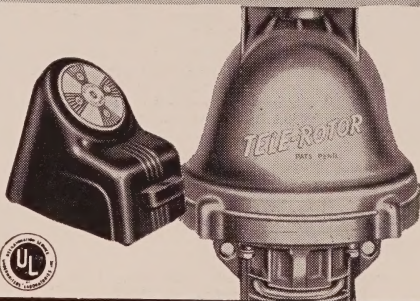
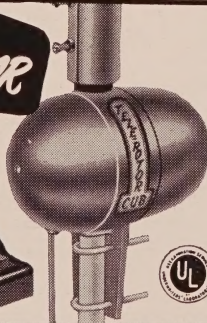
This heavy-duty TELE-ROTOR has no match! It's more powerful... will turn any TV antenna array under any weather conditions. Easily installed... it is trouble-free in performance. Easiest of all to operate!

MODEL TR-2.....rotator with "compass control" cabinet having illuminated "perfect pattern" dial... (uses 8 wire cable) \$49.95



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MODEL 502A.....rotator with plastic control cabinet having indicating meter for "hairline" tuning. (Uses 5 wire cable) \$44.95

MODEL 501A.....rotator with control cabinet having end-of-rotation signal. Light flashes every 7.2° showing antenna is turning. (Uses 5 wire cable) \$34.95



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